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VARIABILITY OF DEEP CONVECTIVE CLOUD CHARACTERISTICS ACROSS THE TROPICAL PACIFIC

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ABSTRACT

Tropical convective clouds are an obvious feature in satellite images of tropical latitudes due to their high shortwave albedos, however, depending on the atmospheric state and large-scale dynamics different convective cloud types can develop. Within a given convective cloud type we may also observe great variability in cloud macro- and microphysical properties. These different cloud types and cloud characteristics may have vastly different impacts on the local water and energy budgets.

We use surface remote sensing observations and soundings from several recent field experiments coupled with a simple entraining parcel model in order to address the following questions about deep convective cloud types: 1) Which environmental factors play a role in determining the depth of tropical convective clouds? 2) What environmental parameters are related to entrainment rate in cumulus congestus clouds? Our results suggest that in regions with a relatively low frequency of deep convection (Nauru Island) a drying of the mid-troposphere is a more likely to be responsible for limiting convective cloud-top heights than a stabilizing of the freezing level. We also find that low- level CAPE and the RH profile account for the largest portion of the variance in cumulus congestus entrainment rates, consistent with the idea that entrainment rate depends on the buoyant production of turbulent kinetic energy. If we limit our analysis to cases where there is a soundign during the hour preceding the cumulus congestus observations we find that the low-level CAPE accounts for 85 % of the total variance in entrainment rate. Likewise, initial results from the Eastern Pacific ITCZ (EPIC 2001) indicate that in regions with more intense deep convection the stability at the freezing level plays a much more important role in limiting the depth of cumulus congestus clouds.

We also present some preliminary results from the analysis of MODIS observations of tropical deep convective systems. The statistical analysis involves the determination of cloud-averaged values of several characteristic data products from EOS Terra and Aqua observations. We use a cloud identification algorithm to define convective cloud elements and concentrate our analysis on two regions of the Pacific, the tropical Western Pacific which has a history of field projects (TOGA COARE) and long-term monitoring site (ARM) and the tropical eastern Pacific region (as sampled during EPIC 2001). We determine general cloud-averaged characteristics of mid- and deep convective clouds as observed by Terra and Aqua (e.g. cloud particle effective size, cloud-top temperature, optical thickness, cloud-top pressure, shortwave albedo) and relate them to characteristics of the surface conditions and the large scale dynamics.